

Carbon footprint of patient journeys through primary care:

a mixed methods approach

Abstract

Background

The NHS has a target of cutting its carbon dioxide (CO₂) emissions by 80% below 1990 levels by 2050. Travel comprises 17% of the NHS carbon footprint. This carbon footprint represents the total CO₂ emissions caused directly or indirectly by the NHS. Patient journeys have previously been planned largely without regard to the environmental impact. The potential contribution of 'avoidable' journeys in primary care is significant.

Aim

To investigate the carbon footprint of patients travelling to and from a general practice surgery, the issues involved, and potential solutions for reducing patient travel.

Design and setting

A mixed methods study in a medium-sized practice in Yorkshire.

Method

During March 2012, 306 patients completed a travel survey. GIS maps of patients' travel (modes and distances) were produced. Two focus groups (12 clinical and 13 non-clinical staff) were recorded, transcribed, and analysed using a thematic framework approach.

Results

The majority (61%) of patient journeys to and from the surgery were made by car or taxi; main reasons cited were 'convenience', 'time saving', and 'no alternative' for accessing the surgery. Using distances calculated via ArcGIS, the annual estimated CO₂ equivalent carbon emissions for the practice totalled approximately 63 tonnes. Predominant themes from interviews related to issues with systems for booking appointments and repeat prescriptions; alternative travel modes; delivering health care; and solutions to reducing travel.

Conclusion

The modes and distances of patient travel can be accurately determined and allow appropriate carbon emission calculations for GP practices. Although challenging, there is scope for identifying potential solutions (for example, modifying administration systems and promoting walking) to reduce 'avoidable' journeys and cut carbon emissions while maintaining access to health care.

Keywords

carbon footprint; patient journeys; primary health care; transportation.

INTRODUCTION

The Climate Change Act of 2008 committed the UK government to an 80% reduction in its carbon emissions (below 1990 levels) by 2050. The NHS, as Europe's largest employer and the UK's largest organisation, contributes a large percentage of the national carbon footprint, and its own carbon-reduction strategy also aims for an 80% reduction in this footprint by 2050. This carbon footprint represents the total carbon dioxide (CO₂) emissions caused directly or indirectly by the NHS. The NHS carbon footprint is made up of travel (17%, including patient journeys; about 8%), energy (24%), and procurement (59%).¹ On a primary care level, The National Travel Survey² identified that in large urban areas in the UK 78% of total distance covered by car or other private transport is for personal travel (including trips to see GP) with 80% of all households within 15 minutes travel time (by foot or on public transport) of a GP. The total distance by car for personal travel increases to 90% of total distance covered in rural areas, and here only 53% of households are within 15 minutes travel time to see a GP. In a health service responsible for 5% of all car journeys in the UK,¹ the potential contribution of 'avoidable' journeys is enormous.

A literature review by the authors found

no systematic review of the impact on carbon footprint of patient journeys in a primary care setting (V Issacson *et al*, unpublished data, 2013). It should be noted that a number of studies have considered how to increase accessibility to primary care settings. Using GIS software, public transport and car travel times to GP practices by home location have been previously determined,³ and others have looked at solutions to reduce the amount of travelling to the primary care practice (for example, introduction of telephone triage),⁴ but none had calculated the impact on carbon emissions from these trips.

Even where (hospital) sites had developed transport policies to reduce their carbon footprint, the evidence suggested they were not being effectively implemented.^{5,6} At a practice level, a tool is currently being assessed by the Royal College of General Practitioners (RCGP) (www.gpfootprinter.co.uk) that will allow primary care practices to calculate their carbon footprint.

METHOD

Research questions

A practice-based case study was used to investigate the carbon footprint of patients travelling to the surgery. There were three research questions:

E Andrews, BSc(Hons), MSc, PhD, senior research fellow, Bradford Institute for Health Research, Bradford Royal Infirmary (formerly Academic Unit of Primary Care, University of Leeds). **D Pearson**, EdD, FHEA, FRCGP, deputy dean (Education) and head of centre (Education Development), Hull York Medical School. **C Kelly**, BA(Hons), MRes, senior research fellow, Academic Unit of Health Economics and Institute for Transport Studies; **L Stroud**, BA, MFP, MPH, head of Student Education in Primary Care and Public Health Academic Unit of Primary Care; **M Rivas Perez**, Institute for Transport Studies, University of Leeds.

Address for correspondence

Liz Andrews, Born in Bradford Project, Bradford

Institute for Health Research, Bradford Royal Infirmary, Temple Bank House, Duckworth Lane, Bradford BD9 6RJ.

E-mail: Elizabeth.Andrews@bthft.nhs.uk; E.C.Andrews@leeds.ac.uk

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How this fits in

There has been little research focusing on the carbon footprint of patient travel within a primary care setting. The majority of journeys in this practice-based case study were made by car, suggesting that this is the area where savings in carbon emissions need to be made to meet NHS targets for 2050. Patients reported mostly travelling to attend appointments and arrange repeat prescriptions, stating time saving and convenience as the main reasons for their choice of travel mode (rather than illness or mobility issues, for example). The research revealed issues within practice administration systems designed for accessing appointments and prescriptions, such that patients travelled to the surgery to make appointments in person rather than via telephone, and to complete paper forms for repeat scripts rather than utilising other options provided by the practice, such as requests via e-mail. However, systems set up to make administration of services easier for the practice can make it more difficult for patients and increase the number of patient journeys. These 'avoidable' journeys, can be, and are being, addressed, and can reduce the practices' carbon emissions via more streamlined systems for delivering health care.

1. What is the carbon footprint of patients travelling to and from a general practice surgery?
2. What factors contribute to these journeys?
3. How can patient journeys and surgery practice be modified to reduce the carbon footprint of these trips?

To answer the first two questions, patients/escorts completed a travel survey (for example, origin and destination postcodes, modes used, and mileage) of their journeys to and from the surgery. Focus groups were then conducted to illuminate answers to research questions 2 and 3. Questions in group discussions explored individuals' experiences, including describing the reasons for choosing a particular mode of travel, issues with accessing health care, their views on climate change, and suggestions for ways of reducing the carbon footprint of the patient journey.

Setting

The case study was based in a medium-sized practice in Yorkshire with approximately 11 000 registered patients, mainly white

(approximately 86%), generally of average age profile for the area (Bradford), although somewhat deprived (the practice falls within the second most deprived decile, Index of Multiple Deprivation score of 36.3).⁷ Initial estimates provided by the surgery prior to the study suggested that approximately 650 patient journeys were made on a daily basis, with the purpose of attendance at the surgery for appointments with healthcare staff and collection of prescriptions. The study aimed for a sample size of 10% of total visits to the surgery, which would provide approximately 65 surveys per day; that is, total sample size of 325. Data-collection methods included quantitative and qualitative approaches.

Quantitative data collection

The travel survey was conducted during 1 week in March 2012, Monday to Friday between 8am and 6pm. Patients ($n = 306$) completed the surveys in the practice reception area. Twelve patients approached declined to participate, mostly stating 'lack of interest'. Responders were approached by one of three researchers, and gave their verbal responses to questions about their travel. The survey was developed to collect data on the modes of transport patients were using to travel to and from the practice and the reason(s) for their choice, and the distances travelled, in order to calculate the carbon footprint associated with the trip. Distance was included in the survey: patients were asked to estimate the distance they had travelled, as well as to provide their starting and destination (after visiting the practice) postcodes.

Calculating the carbon footprint. Using the ArcInfo GIS software package, the origin and destination of patient journeys collected from the survey were mapped, along with home locations and the location of the GP surgery. The geographical location of the journey origin and destination and home locations was derived from the postcodes provided by patients. This information was geo-referenced using the postcode area centroid data in the OS Ordnance Survey Codepoint dataset. In urban areas, the average area of a postcode is approximately 8000 m², so each address is generally within 40 metres of its actual location. Using ArcGIS, the 'as-the-crow-flies' route of each journey was mapped and the distance of the total journey and of the journey stages was calculated on this basis.

The distances calculated through the GIS mapping were used in two key ways: first, to determine the distance by mode

Table 1. Information from travel survey on journeys to and from surgery

Mode of travel	Journeys to surgery		Journeys from surgery	
	<i>n</i>	%	<i>n</i>	%
Car	179	58.5	168	54.9
Bus	29	9.5	30	9.8
Taxi	16	5.2	11	3.6
Walk	76	24.8	91	29.7
Other (train, motorbike)	6	2	6	2

based on the trip from the origin postcode to the surgery and from the surgery to the destination postcode; secondly, to consider those trips that had different starting and ending postcodes (for example, home to surgery to work), in order to calculate the carbon emissions attributable to the surgery.

Qualitative data collection

Two focus groups were conducted in May 2012 with NHS clinical staff (*n* = 12), including GPs, GP trainees, practice nurses, and non-clinical staff (*n* = 13), including administration and reception staff and the practice manager. The focus groups

followed a semi-structured topic guide based on the literature. They sought to explore issues around mode of transport, accessibility of the practice, and availability of alternative modes and ways of reducing patient carbon emissions. The results are presented according to the emergent themes, and supported by illustrative quotations.

RESULTS

The quantitative and qualitative data analyses are presented separately.

Quantitative data: Travel survey

Three hundred and six participants completed the travel survey. There were 183 female responders and 118 male responders (data were missing for five responders). Seventy-eight per cent were <65 years of age. The survey data showed that the majority of patients/visitors (*n* = 271, 89%) were attending for appointments (including escorting a patient), 24 were related to repeat prescriptions (21 collecting, three renewing), nine were coming to book appointments, one was registering with the practice, and one arranging a death certificate.

The majority of patients travelled to and from the surgery by private car (Table 1). Cars, taxis, and buses accounted for just over 75% of journeys (inward to surgery), with just over 70% on the onward journeys. The quantitative differences in inward/onward journey modes in Table 1 is because patients were not necessarily returning to their home/origin, nor were they necessarily travelling by the same mode. The data show that about 25% of the inward journeys (to the surgery) were made by walking, while almost 30% of the onward journeys (from the surgery) were made by walking. For example, survey responder number 286 stated:

'... I normally walk but was late so husband gave me a lift [by car]. Walking back home.'

No survey responders reported cycling, although the surgery reports that a small number of their patients do cycle.

Quantitative data: ArcGIS mapping

The map in Figure 1 was produced from postcode data using ArcGIS, and shows the patient journeys made by car to the surgery. The majority of car journeys (62%) made were within 2 miles (3.2 km); 31% were within 1 mile (1.6 km), 14% within half a mile (0.8 km), and 4% were within one-quarter of a mile (0.4 km). Another map detailing

Figure 1. GIS map of car journeys made to surgery originating within 2 miles of the practice.



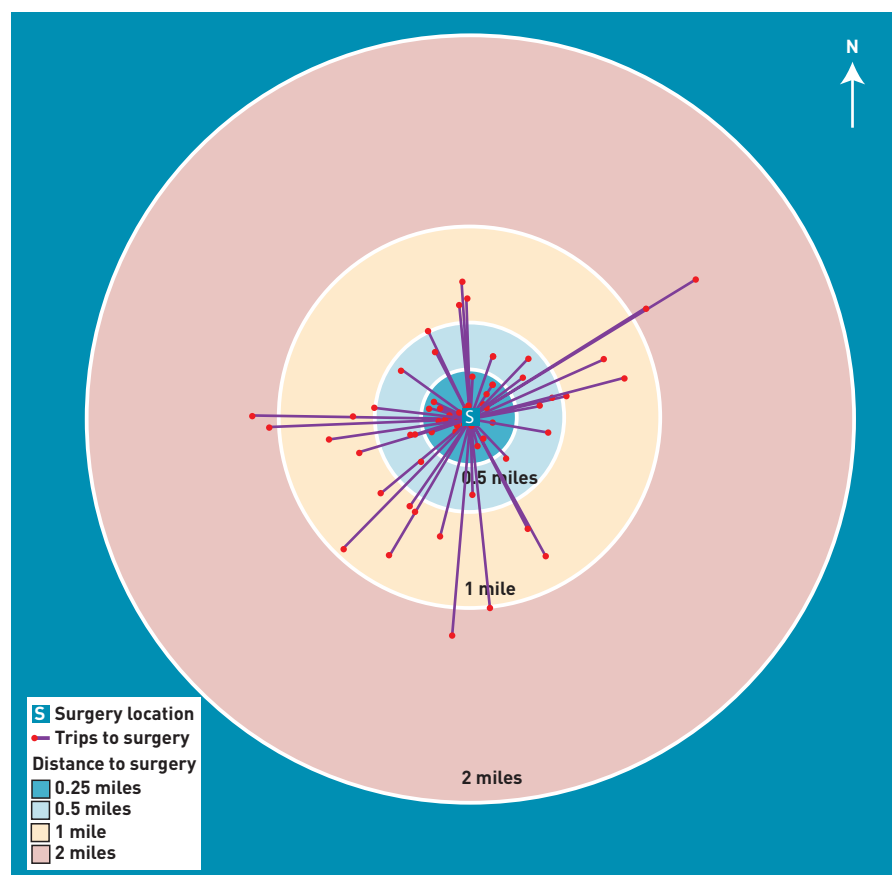


Figure 2. GIS map of journeys made on foot to surgery originating within 2 miles of the practice.

journeys where patients walked to the surgery (Figure 2) shows that most patients (64%) were walking within 1 mile, 46% were walking within half a mile of the surgery, and 22% were walking within one-quarter of a mile. The remaining patients were walking much further, between 2 and 4 miles.

Carbon footprint of the practice. The distance data collected in the survey (based on journey start and end postcodes) were annualised to annual kilometres by mode of transport, using the number of patient appointments in the week of the survey and the assumption that the practice was open 50 weeks of the year. This annual data were then converted into CO₂ emissions, using Department for Environment, Food and Rural Affairs (DEFRA) conversion factors,⁸ as shown in Table 2, and converted to tonnes of CO₂.

Carbon emissions provided in Table 2 assume that the distances that patients travelled were all attributable to the surgery. However, calculations that evaluated the distance where patients had differing origins and destinations (29% of the sample) resulted in a lower patient travel carbon footprint of 44.70 tonnes CO₂ emissions. This recalculation is based on the assumption that patients who had different starting and end points were going to make the trip anyway, and it is only the additional distance deviating from the existing trip that should be attributed to the surgery; for example, they were going shopping and have made their appointment and called in to the surgery as part of this trip.

The calculations in this article are based on the journey start and end postcodes provided by the participants and on the 'as the crow flies' distance using GIS modelling. The study also asked participants to estimate the distance that they had travelled to get to the surgery. A comparison between the two identified that those that walked, on average under-estimated the distance and those that drove over-estimated the distance that they had to travel to get to the surgery. A full description of the methodology and comparisons between methods will be provided in a future study [C Kelly *et al*, unpublished data, 2013].

Qualitative data

From the quantitative results above, it was evident that the majority of journeys to the surgery were made by car or on foot. The focus groups and survey responses presented below were used to explore the reasons for this (for example, why were individuals not using public transport and/or walking instead of driving) and consider possible solutions for reducing the practice's carbon footprint for patient travel.

For quotations, a number following a quotation, for example, No.10, refers to the survey number, and therefore a patient, N9, for example, is a non-clinical member of

Table 2. Practice carbon footprint (vehicle km, CO₂ conversion factors⁸ and CO₂ emissions)

Vehicle type or travel mode	Engine size, l	Annualised distance, km	Kg CO ₂ per km (conversion factor) ^a	Annual CO ₂ emissions, tonnes
Diesel car	Average diesel	7332	0.1918	1.41
	Large (>2)	37 185	0.2416	8.98
	Medium (1.4–2)	71 159	0.1792	12.75
	Small (<1.4)	6989	0.1433	1.00
Petrol car	Average petrol	14 588	0.2076	3.03
	Large (>2)	23 828	0.2981	7.10
	Medium (1.4–2)	39 703	0.2111	8.38
	Small (<1.4)	83 072	0.1701	14.13
Bus, passenger		38 526	0.1475	5.68
Train, passenger		6066	0.0501	0.30
Walk		62 327	^b	^b
Cycle		0.00	^b	^b
Total				62.76

^aArcGIS (<http://www.esri.com/software/arcgis/index.html>). ^bNo carbon emissions are associated with these travel modes.

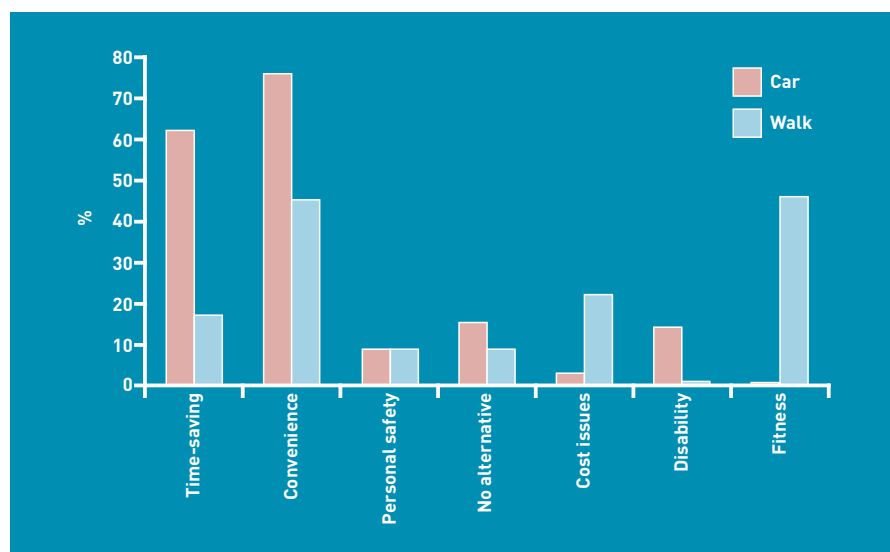


Figure 3. Percentages of free-text responses for reasons for travel mode choices.

staff, and C4, for example, is a clinical staff member.

Travel mode choices. The results of the closed question in the survey are presented in Figure 3, which shows the percentages of free-text responses describing patients' reasons for their choice of travel mode (car and walking).

Using the car to travel to the surgery was justified through a number of differing reasons. Only one patient who completed the survey stated illness as the reason for coming by car. This is contrary perhaps to expectations. Clinical staff thought that this would be one of the main reasons why patients travelled in by car (and did not walk); for example, one member of staff stated that:

'... I think ... they don't walk because they are ill.' (C5)

However, another staff member considered that cars might be used more habitually:

'... Well I think they come by car because they live by the car and they can't do without the car, personally. You know if you've got a car you just use it don't you?' (N6).

The main reason for driving (Figure 3) was that responders felt that it was quicker to drive than using alternative modes of transport. One individual stated that:

'... I travelled from girlfriend's house. I used car because 2-hour bus journey.' (No. 104).

In this case, the difference in travel

time would have been significant. Another patient stated that:

'... [it] takes too long to travel otherwise.' (No. 27)

Another person considered the car as a quicker and more convenient travel mode (at least occasionally), stating that:

'[I] ... used car for convenience and time saving [today]. I usually walk.' (No. 181)

If this patient had walked, the distance would be a total of 1.75 miles.

The quantitative results identified that, in the survey, on average, individuals over-estimated the distance they had travelled by car. One patient stated they used their car because of the

'... distance [I] have to travel.' (No. 25)

For this individual, the GIS mapping indicated that it took 2.5 miles by car, but they estimated that their journey was 4 miles by car. Although 2.5 miles is quite a distance to walk, some patients did walk this distance and much further, as highlighted earlier in the quantitative results section.

Those who walked to the surgery similarly had a number of reasons for doing this (Figure 3). Walking was often chosen as a travel mode because patients lived conveniently close to the surgery or they were not time constrained, for example:

'I walked because I live nearby.' (No. 10)

'I had time to walk.' (No. 34)

Other reasons included walking for exercise and/or retaining mobility or walking because of financial considerations:

'I walk to keep up my mobility.' (No. 7)

'... normally walks. No car and out of work.' (No. 191)

Patients were also more likely to report a mode choice according to whatever mode was available or more convenient for themselves, for example:

'... [I] always walk inward journey. Easier to return by bus.' (No. 100)

'... if my husband is around I come with him [by car] but normally I walk.' (No. 59)

The National Travel Survey indicates that

for the category 'personal business', which includes trips to the GP, on average those individuals walked 0.62 miles per trip for this purpose; that is, a distance of 0.31 miles both ways.⁹ If this distance is compared to the distances shown on Figure 1 of car journeys made within 2 miles of the surgery, then it is evident that a significant number of these journeys could potentially be made on foot.

In terms of other alternative travel mode options, 'time issues' and 'cost' were major reasons for not using public transport (Figure 3). The lack of alternative options typically related to a lack of, or a reduced, bus service, or a bus timetable and schedule not suitable for patients' needs, for example:

'... bus only runs hourly.' (No. 193, used taxi)

Patients mostly reported private car or taxi as their main alternative to using buses. The location or distance to the nearest bus stop is also problematic for those patients with mobility difficulties:

'... lack of bus service plus 1 mile to nearest bus stop and could not walk that far.' (No. 42, used car).

Some patients used a bus if the timing fitted with their schedule, for example:

'... getting bus home if one due ... Buses are only one every 30 minutes.' (No. 65)

Some patients fitted their appointments around the bus schedule so that they could use their bus pass (time-restricted fare concessions), for example:

'[I] don't have a car. Have to book appointment after 9.30am for free travel.' (No. 86)

Focus groups: potential solutions

Focus groups were conducted to discuss potential solutions to the ways that carbon emission reductions can be achieved by the practice. One of the solutions they considered was how to encourage patients to consider alternatives to using the car for travel to the practice. For example, there is scope for encouraging patients to walk as their mode of travel, as one member of staff stated:

'... I think people's perceived ideas about their levels of fitness are better than they think they are ... you know, looking at buses and taxis when actually they could walk.

Maybe we just need a big sign in the waiting room saying "We encourage you to walk and not use your cars"?' (C3).

Other major potential solutions related to the administration systems in place for patient appointments and prescription services. Groups discussed at length possible changes in the way some services are delivered to patients, which currently seem to be encouraging patients to make additional journeys into the practice.

Patient appointments. From the survey and from observation during data-collection week, it was noted that many people were coming into the surgery reception to make appointments in person. It was often the case that a patient would come in early morning to make an appointment for later the same day. For example:

'... I live nearby [came by car]. Came in to make an appointment as difficult to get through on phone and appointments all taken up by the time you get through.' (No. 168)

'... It's [patients coming into reception to make an appointment] been a bit of an ongoing problem. We [try] to get patients to ring later on during the day if they are not needing an appointment on the day so that the phones are free for those that do need it on the day. But I think that's why people come in. Because they think, rather than trying to get through on the phone and missing the appointments.' (N9)

It appears that patients are not clear about the systems in place for ensuring that patients are seen on the day if they need an emergency appointment. This information is available on the practice's website and they also highlight this information in their newsletters.

Patients calling into the surgery in person to make appointments have been a long-term problem for the practice and it is in the process of considering using an online booking system. However, as highlighted by a member of staff, this may not solve all the issues in this area.

'... But then if you haven't got access to the internet and you are 85 then that ... and you're not a "silver surfer" ... It actually then reduces equity.' (C5)

Repeat prescriptions. Another potential carbon-reduction strategy relates to reducing the numbers of patients calling in

person to collect repeat prescriptions and to renew prescriptions, for example:

'... my repeat prescription not ready for collection. Coming back in the afternoon.' (No. 160, came by car)

Again, patients may be unclear about the options for renewing prescriptions:

'... They might come more often because they don't think about ordering things like prescriptions over the internet so they're coming into the surgery — if they knew they could order it, if they have got internet or e-mail or even through a chemist you know, so they are making the journey themselves. Maybe if they choose a pharmacy, perhaps in a supermarket say, just collecting it when they are doing their shopping or you know just do that journey together.' (N9)

Repeat prescription requests can be made via e-mail and the surgery has a system for repeat prescriptions in which patients can nominate a chemist where their order can be delivered and can be collected direct from the pharmacy, for example, while supermarket shopping.

Getting the message to patients. The practice has an electronic sign in reception that patients are checking continuously, because this is where they are given the information that the doctor is ready to see them, and the relevant room number. The practice decided they could make good use of this to also address some of the issues highlighted earlier. For example:

'We have our rolling message thing — so "Have you walked today?" "Did you need to come by car?" — because that gets seen ...' (C4)

The practice is now actively encouraging patients to consider the way they travel to the surgery, to reduce 'avoidable' journeys in response to research findings. The practice is continuing its efforts to ensure patients have up-to-date information with respect to their options for making appointments and ordering repeat prescriptions.

DISCUSSION

Summary

This single-practice-based case study has shown that the majority of journeys made by patients were for healthcare appointments and were made by motorised modes of transport (such as, a car or taxi), with the majority of these made by

private car for relatively short journeys (that is, within 2 miles of the surgery). It is clear that, to meet NHS targets,¹ any reductions in patient carbon emissions will need to address patients' car journeys. The findings from the survey and focus groups show that the main reasons for patients' choice of travel mode included time saving, convenience, cost consideration, and a lack of alternative options; that is, reduced bus services. The cost of travel by public transport was also a factor, with journeys by taxi cheaper than by bus, owing to competition between taxi companies in the local area. There was scope in this project to accurately consider the distance individuals are travelling to visit their GP, to calculate the CO₂-equivalent carbon emissions for the practice and therefore the required reductions needed, to uncover patients' reasons for mode of travel choices, and to identify potential solutions to cutting carbon emissions while maintaining or increasing access to the practice.

For the NHS, travel accounts for 17% of its total carbon footprint (that is, the CO₂ emissions caused directly or indirectly by the NHS), and about half of this footprint relates to patient journeys. It is important to note that the carbon footprints of general practices will be significantly less than those generated by patient travel to major hospital centres. The potential contribution of 'avoidable' journeys in primary care is, nevertheless, significant. The practice in this study is taking steps to reduce its footprint by actively encouraging patients to consider the way they travel to the surgery; making sure that patients are aware of all the options for making appointments and ordering repeat prescriptions; and looking to improve existing administration systems so that patients can avoid making additional journeys to the surgery.

Strengths and limitations

A major strength of this study is that the chosen practice surgery supported the research project from inception (and was actively seeking ways to deliver 'sustainable' health care prior to this work). Patients and visitors were also interested in the research, responding in a positive way and willing to complete the travel survey.

One limitation of the study was that the survey data did not completely reflect the numbers of people who were calling in person at the surgery to book healthcare appointments or collect and renew prescription requests. Further, it was intended to hold three focus groups, but it proved difficult to recruit a patient

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Ethical approval

Ethical approval was given by the NHS Ethics Committee (REC Ref. 12/YH/0042, 23 January 2012).

Provenance

Freely submitted; externally peer reviewed.

Competing interests

The authors have declared no competing interests.

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group despite three arranged meetings. Data from qualitative responses to travel survey questions regarding patients' choice of travel mode and the reasons for their choices were available and were included in qualitative analyses, but they necessarily lacked the detail that would have been provided by focus group interviews with patients. Methods for collecting patients' views will need to be addressed in future proposals.

Comparison with existing literature

The literature review (V Issacson *et al*, unpublished data, 2013) indicated that very little work has been conducted to examine the carbon footprint of patient travel in primary care settings. It was clear from the present case study that the main issues related to problems with accessing appointments and repeat prescriptions, which meant that patients were making additional or 'avoidable' journeys to the surgery. Given that cars contribute the most to the practice carbon footprint, changes in the way patients access the surgery and/

or the way the practice delivers services will need to be made if the practice is going to meet the NHS target of 80% reductions on 1990 levels in carbon emissions by the year 2050.¹

This report will help to both inform clinicians of the issues and raise awareness of the ways that patients travel to appointments, and the ways in which practices can contribute to reducing emissions with the co-benefit of improving the health of patients; that is, by encouraging them to use cars less and walk more.

Implications for research and practice

Future large-scale work might include extending the research to include other practices and settings; a cohort study of patients perhaps based on selected primary care practices or particular patient groups (for example, patients with diabetes); a possible intervention study aimed at changing behaviours to reduce carbon footprints; or action research working with previously selected practices and/or patient samples.

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